

Country Report Germany

Presented by Thomas Willke

Federal Agricultural Research Centre (FAL),

Braunschweig

Institute of Technology and Biosystems Engineering

Second IEA Bioenergy Task 42 Meeting

4/5 October 2007, Vienna, Austria

1. Introduction

Drivers for biorefineries

- limited amounts of non renewables (oil, coal, uranium, phosphorus,...)
- global warming due to CO₂, methane and others
- Increasing amounts of wastes (solids, water, air, particulate matter)
- decreasing income in rural areas
- ...

1. Introduction

Possible Solutions

- Switching from oil based industry to biomass based industry (energy 90%, chemicals and materials 10%)
- Saving energy and feedstocks
- Thinking in circles (closed loop recycling management)
- Combining renewables (biomass, sun, wind, water,...)
- Development of new technologies
- Technology transfer

2. Current national biomass use (Overview)

- **Wood**
 - Energy (powerplants, domestic fuel)
 - paper, pulp
 - construction, industry
 - Materials
- **Oil (rapeseed, sun flower)**
 - biodiesel
 - lubricants
- **Sugar, starch (beat, wheat, potatoe, maize)**
 - chemicals
 - materials
 - fermentation products (Ethanol, organic acids, fine chemicals)
- **Energy plants (maize, grain, grass silage) 500 kw elektr. 30t/tag 8000 h/a.**
 - biogas
- **Residues (agriculture, industry)**
 - biogas
 - composting

Country Report “Identification Current Processing Potential and Mapping Existing Biorefineries”

2. Current national biomass use (potential)

Year	Source	Cropland for renewables [Mio. ha]	Share of actual used cropland* [%]
2005	BMELV	1,4	11,9
2010	Öko-Institute / DLR	1,94 - 2,5	16,6 - 21,2
2030	Öko-Institute / DLR	3,26 - 4,3	27,9 - 36,4
2050	Öko-Institute / DLR	3,94 - 6,1	33,7 - 51,7

* 11,8 Mio. ha (2003)

providing a yield of 10 t/ha, feedstock potential in 2050 is about 40-60 Mio. t (up to 1000 PJ)

3. Biomass-related national policy goals legislation

- **Renewable Energy Law (EEG)**
 - Guaranteed constant benefits for feed in of renewable energy
- **Wastewood Law (AltholzV) 3/2003**
 - regulate the usage
- **Biowaste Directive (BioAbfV) (1998, modified 2006):**
 - Direct the usage of biowaste (domestic, landscape conservation, food residues (kitchen, canteen))

3. Biomass-related national policy goals

Biofuel Quota Law (BiokraftQuG) 1/2007


Year	Biodiesel engine quota	Biofuels (Otto) quota	Combined quota
2007	4.4 %	1,2 %	-
2008	4.4 %	2,0 %	-
2009	4.4 %	2,8 %	6,25 %
2010	4.4 %	3,6 %	6,75 %
2011	4.4 %	3,6 %	7,00 %
2012	4.4 %	3,6 %	7,25 %
2013	4.4 %	3,6 %	7,50 %
2014	4.4 %	3,6 %	7,75 %
2015	4.4 %	3,6 %	8,00 %

3. Biomass-related national policy goals

CO₂-reduction

Council order 9.3.2007

- Share of renewables from actual 6,4% to 20% in 2020
- Reduction of 20 % until 2020 (Cancelor Merkel, EU)
- Opositional „Green Party“ demand 30 % and 25 % (non regarding nuclear power)

 Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz


Future situation for Biofuels in Germany

New energy tax law for Germany coming into force August 2006
This law regulates the market for pure biofuels.

	Biodiesel	Pure Plant Oil
2006-07	9 cts/ltr.	0 cts/ltr.
2008	15 cts/ltr.	10 cts/ltr.
2009	21 cts/ltr.	18 cts/ltr.
2010	27 cts/ltr.	26 cts/ltr.
2011	33 cts/ltr.	33 cts/ltr.
2012	45 cts/ltr.	45 cts/ltr.

(Fossil Diesel taxation 47 cts/ltr.)
Agricultural consumption stays tax free.

E85 15 % of gasoline tax (r. a. 10 cts/ltr) and review of overcompensation

[Contact and receive help](#) 

4. Mapping of Existing Biorefineries

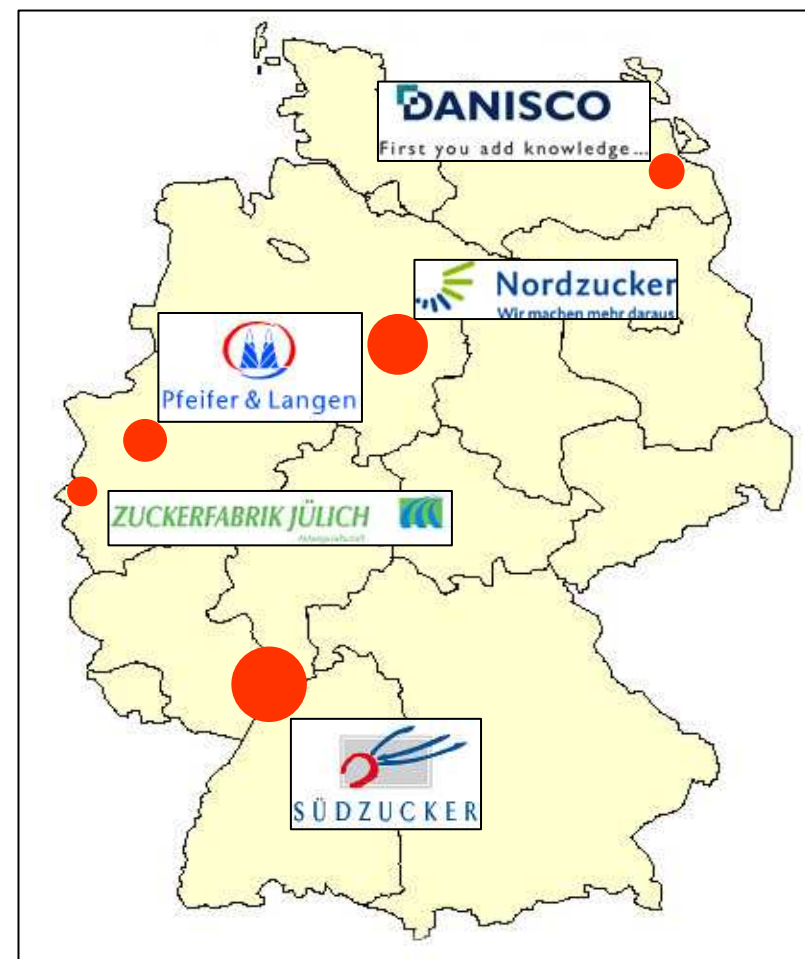
Primary agricultural sector (small-scale initiatives)

Mainly biogas plants

- Decentral small plants
- Usage of local residues, manure and energy crops
- Producing electric power to use benefits from EEG
- Problem: waste heat, normally not used, i.e. low efficiency

4. Mapping of Existing Biorefineries (Sugar)

Danisco Sugar, Germany, Anklam	
Nordzucker AG, Braunschweig	
Pfeifer & Langen KG, Köln	
Südzucker AG Mannheim/Ochsenfurt	
Zuckerfabrik Jülich AG	

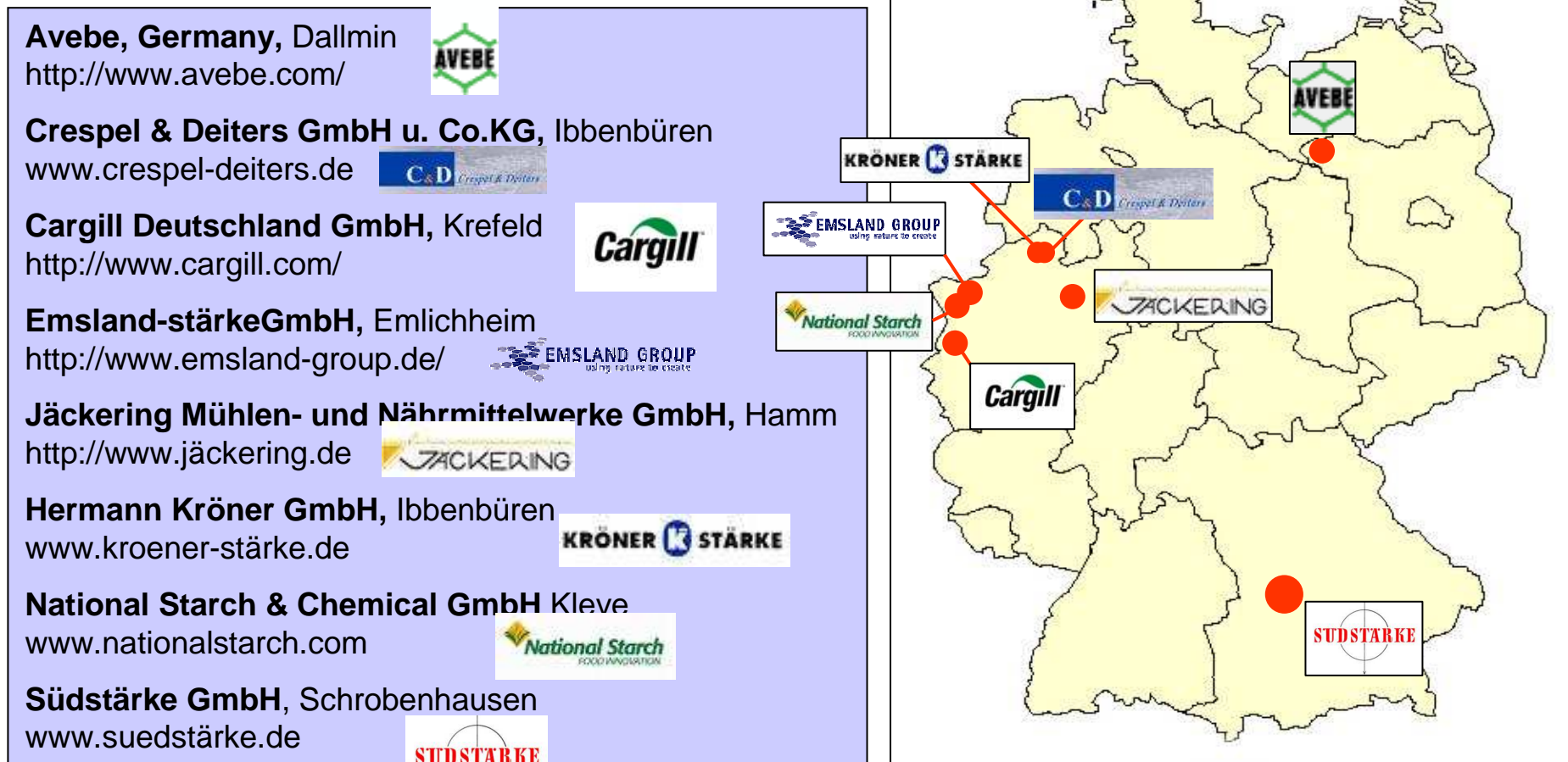


4. Mapping of Existing Biorefineries (Sugar)

Company (sugar factories in Germany)	Sugar production [mio tons /year]	Employes
<i>Danisco (1)</i>	<i>0.15</i>	<i>135</i>
<i>Pfeiffer& Langen (5)</i>	<i>Capacity: > 0,05 t/d</i>	<i>675</i>
<i>Nordzucker (6)</i>	<i>0.9 (1.6 incl. abroad)</i>	<i>3600 (all)</i>
<i>Südzucker (11)</i>	<i>1.4 (4.6 incl. abroad)</i>	<i>1860 (only sugar)</i>
<i>Zuckerfabrik Jülich AG</i>	<i>k. A.</i>	<i>k. A.</i>

4. Mapping of Existing Biorefineries (Starch)

Non-food Industry (materials, products, ...)








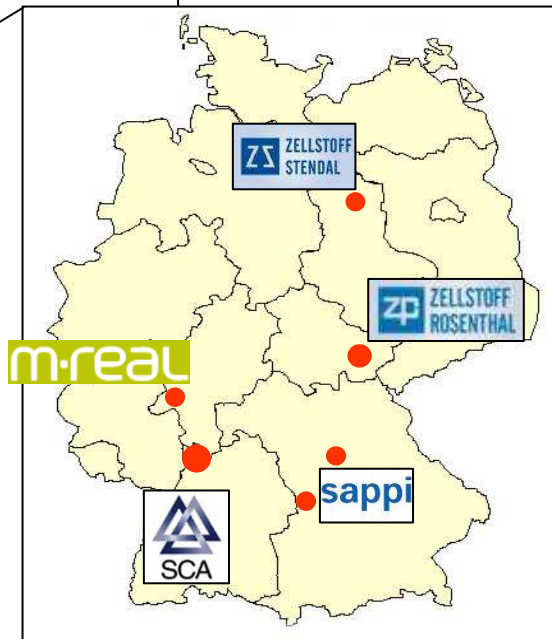
4. Mapping of Existing Biorefineries (pulp/paper)

Paper & Pulp industry in Germany (www.vdp-online.de)

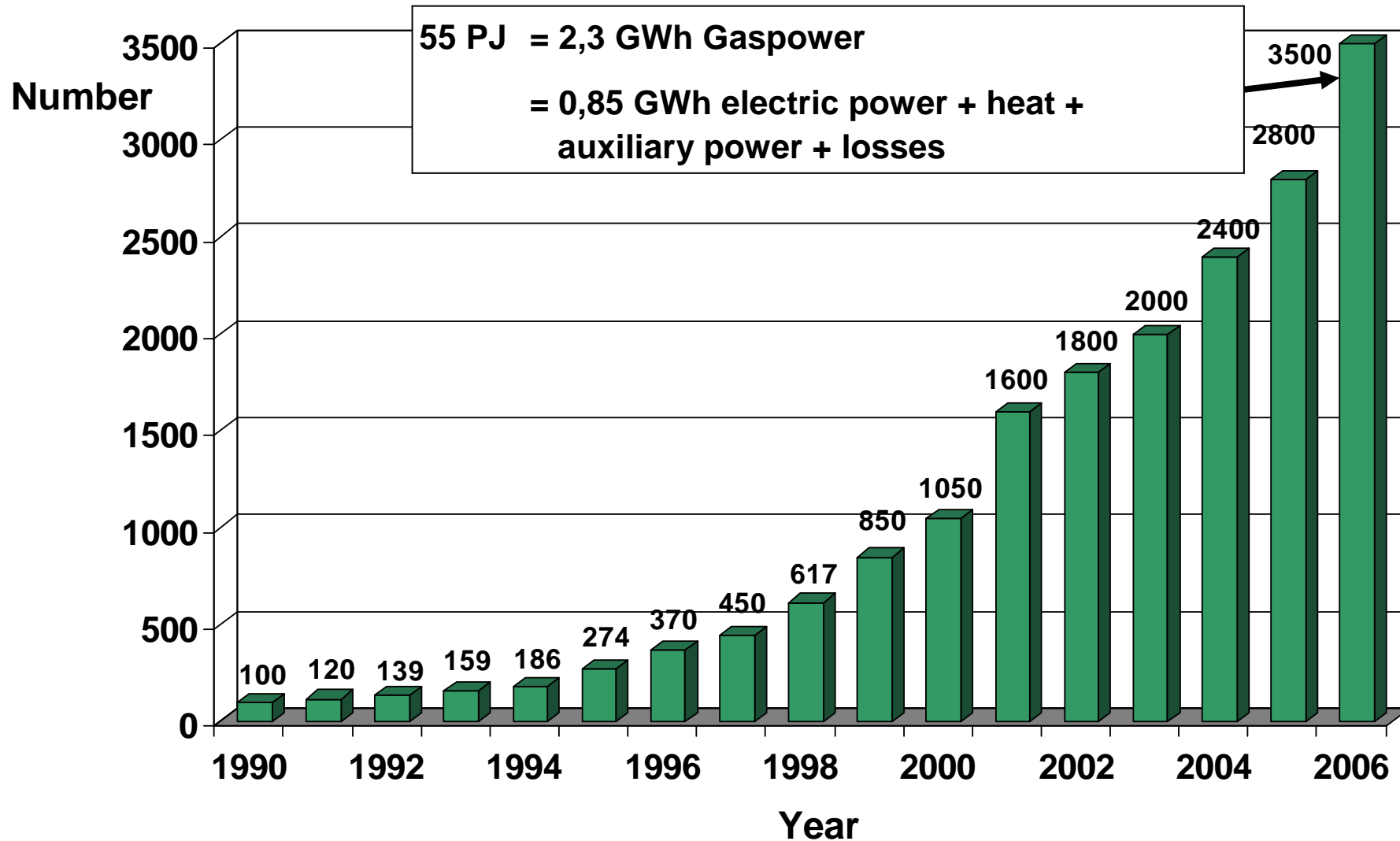
- 210 production sites with 46,000 employees
- 21,6 t paper, 3000 different varieties
- Total turnover: 13 billion €

Only Pulp-production

- M-real Stockstadt GmbH, Stockstadt 
- Rosenthal GmbH, Blankenstein 
- Sappi, Ahlfeld u. Ehringen 
- SCA-Hygiene Products GmbH, Mannheim 
- Zellstoff, Stendal, Arneburg 

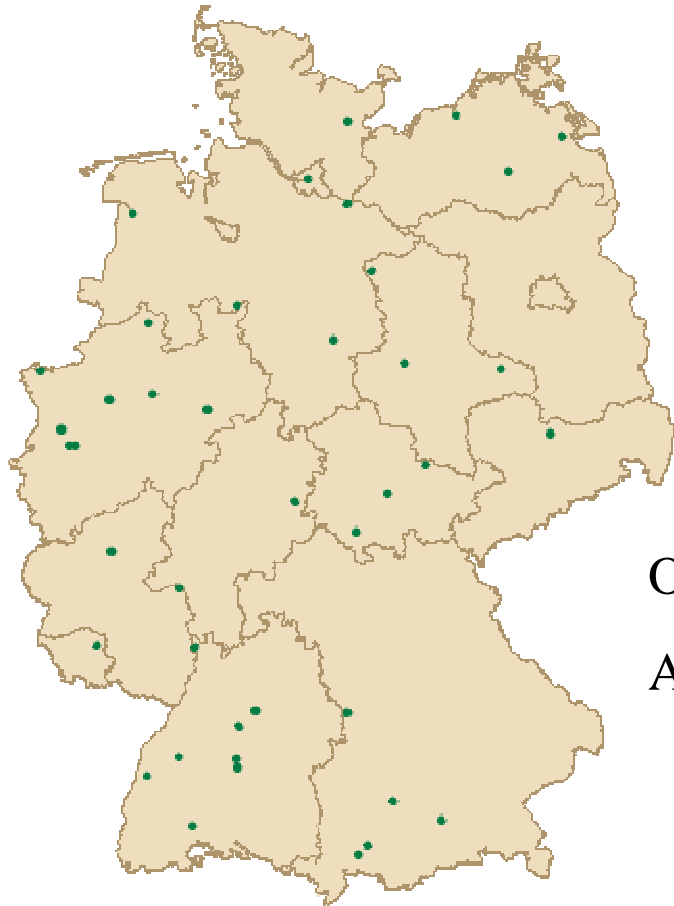


Biogas plants in Germany



Country Report "Identification Current Processing Potential and Mapping Existing Biorefineries"

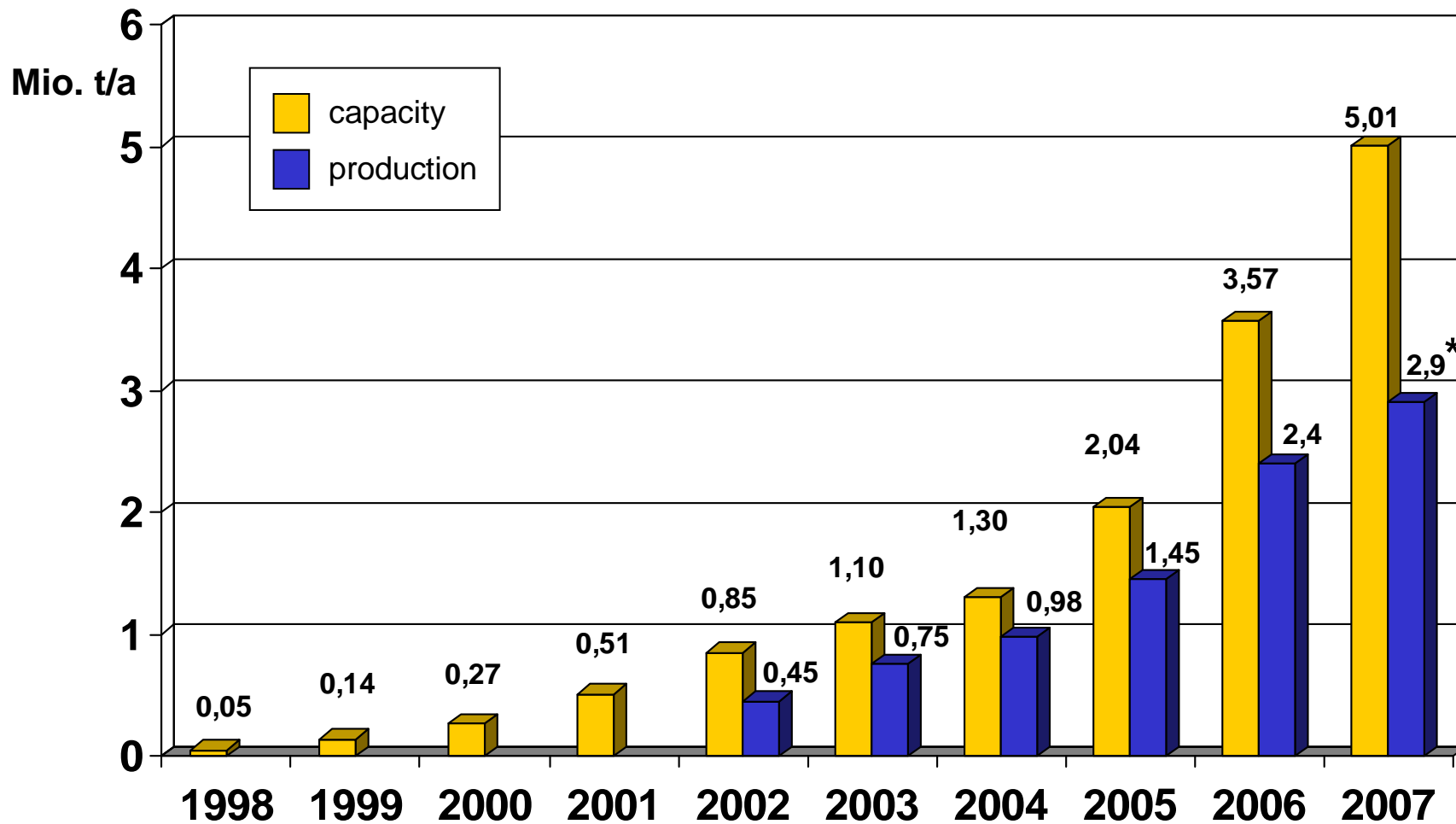
4. Mapping of Existing Biorefineries (Biodiesel)



Oil mills in Germany

All details (interactive) at www.fnr.de

Biodiesel Plants in Germany



Source: VDB, UFOP, *estimated

4. Mapping of Existing Biorefineries (Bioethanol)

Crop energies, Zeitz 

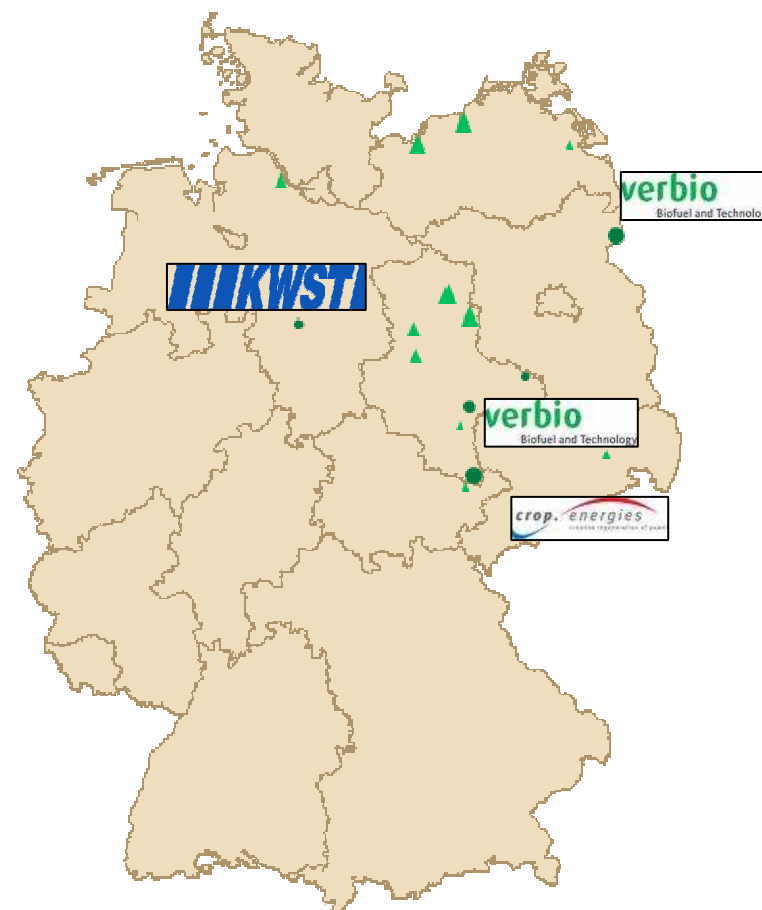
Verbio AG Zörbig & Schwedt 

KWST, Hannover 

B. Icking KG, Seyda

Diverse under construction























See details at www.fnr.de (interactice)

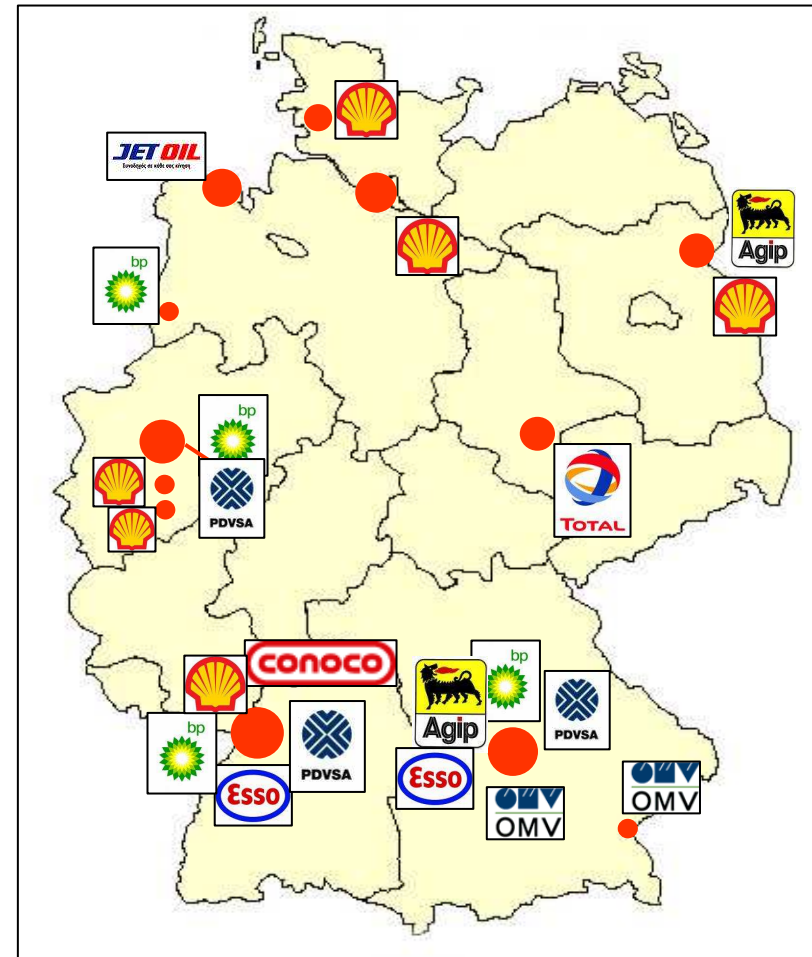


Bioethanol plants in Germany

Plant	Location	Feedstock	Status	Capacity [m ³ /a]
Crop Energies AG (Südzucker AG)	Zeitz	sugar 39.000 ha, grain 94.000 ha	running since 6/2005	260.000
Verbio AG formerly: MBE - Mitteldeutsche BioEnergie GmbH & Co. KG	Zörbig	grain 36.000 ha, 30% regional	running since 1/2005	100.000
Verbio AG formerly: NBE - Nordbrandenburger BioEnergie GmbH & Co. KG	Schwedt	grain 113.000 ha (rye)	running since 9/2005 <i>(Production stopped in Sept 07)</i>	225.000
KWST-Hannover (Kraul & Wilkening and Stelling KG-GmbH & Co.)	Hannover	Molasses	Since 10/2000	20.000
B. Icking KG	Seyda	grain	since 4/2005	4.000
Diverse (Nordzucker, Danisco, PROKON, NAWARO, WABIO, Diverse)	diverse	Grain, sugar ca. 120.000 ha	Under construction	360.000

4. Mapping of Existing Biorefineries (petrochemical)

- Erdölwerk Hollstein, Heide 
- Elbe-Mineralölwerke, Hamburg 
- Holborn Europaraffinerie, Hamburg
- Wilhelmshavener Raffineriegesellschaft, Wilhelmshaven 
- Erdöl Raffinerie Emsland, Lingen 
- Ruhr Öl, Gelsenkirchen  
- Rheinland Raffinerie Godorf, Köln 
- Rheinland Raffinerie Wesseling, Wesseling 
- PCK-Raffinerie, Schwedt  
- Total-Raffinerie, Spargau 
- MiRO, Oberrhein, Karlsruhe     
- Bayernoil, Ingolstadt    
- Esso Raffinerie, Ingolstadt 
- OMV Deutschland, Burghausen 



Petrochemical Refineries in Germany

<u>Company</u>	<u>Location</u>	<u>Association</u>	<u>Capacity</u>	<u>Market share</u>
Erdölwerk Holstein	Heide	Shell	4,50	3,9%
Elbe Mineralölwerke	Hamburg	Shell	5,10	4,4%
Holborn Europa Raffinerie	Hamburg	Holborn	4,65	4,0%
Wilhelmshavener Raffinerieges.	Wilhelmshaven	ConocoPhillips (JET)	10,3	8,9%
Erdöl-Raffinerie Emsland	Lingen	BP	4,0	3,5%
Ruhr Oel	Gelsenkirchen	BP/PdVSA	12,9	11,2%
Rheinland Raffinerie Godorf	Köln	Shell	9,8	8,5%
Rheinland Raffinerie Wesseling	Wesseling	Shell	7,0	6,1%
PCK Raffinerie	Schwedt	Shell/Ruhr Öl/AGIP	10,8	9,3%
TOTAL Raffinerie	Spergau	Total	11,1	9,6%
MiRO Mineraloelraffinerie Oberrhein	Karlsruhe	Shell/Esso/BP/PdVSA/Conoco	14,9	12,9%
Bayernoil Betriebsteil Vohburg	Ingolstadt	OMV/AGIP/BP/PdVSA	6,0	5,2%
Bayernoil Betriebsteil Neustadt	Ingolstadt	OMV/AGIP/BP/PdVSA	6,0	5,2%
Esso Raffinerie Ingolstadt	Ingolstadt	Esso	5,0	4,3%
OMV Deutschland	Burghausen	OMV	3,5	3,0%

source: Mineralölverband und data of Refineries

5. RTD-activities - FNR Project support

Programms (about 50 Mio € per year)

1. Research Programme „Renewable Resources“ (production chains, applications, information and marketing)
2. Market Introduction Programme Renewable Resources (bio-lubricants, biofuels, natural insulating materials)
3. Directive on Bioenery Demonstration Projects Examples 12/2006-12/2010 (proven at pilot state, state of art, commercial scale, investment grant **or** operational cost allowence)
Expl. Innovative utilization of biogas

5. RTD-activities - FNR Project support

Running Projects

Lignocellulose-Biorefinery (Dechema, Fraunhofer-ICT, BFAFH Hamburg, Bayer, Solvent Innovation GmbH)

- German National Project: Lignocellulosic Feedstock biorefinery
- Coordination: DECHEMA (Frankfurt)
- Research and development
- preparation of cellulose, glucose, hemicellulose, xylose and lignin as well as testing of carbohydrates for fermentation processes
- Using of ionic liquids, new enzymes for hydrolysis
- 16 partner from University and Industry as well as Research Institute Biopos e.V., Teltow-Seehof, 1,9 Mio €

5. RTD-activities – BMBF-Projects

A: BioIndustry 2021-Competition

- Submitted: 19 BioIndustry-Cluster (57 companies and 34 Research TW2 Institutes)
- Awarded: 5 Cluster
- Expl. (pos 1): **BioPro-Cluster: Biopolymers and Biomaterials**, Stuttgart-Baden-Wuerttemberg: BioIndustry 2021-Competition Baden-Wuerttemberg Support: 5 Years, 10 Mio. €

B: International: IG-Biotech (Indonesia-German Biotech Cooperation)

- Topic: **Biotechnological conversion of raw-glycerol to high value products for polymer chemistry**
- German Partners: Fraunhofer IME, -ICT, -WKI, BMA, FAL, Synthopol, Glyctec (Biopetrol)

Country Report “Identification Current Processing Potential and Mapping Existing Biorefineries”

5. RTD-activities

Pilot Plants (1)

*Green Biorefinery at Leibniz Institute for Agricultural Engineering Potsdam-Bornim (ATB): Continuous production of **Lactid acid**,*

- *Location: Potsdam-Bornim in Brandenburg*
- *Operation: since 10/2006*
- *Capacity: 10 t/a*
- *Feedstock: Sugar/Starch, e.g. rye*
- *Costs: 3,2 Mio € (EU –EFRE 75 % , Brandenburg-ILB 12,5 % , BMELV 12,5 %)*

5. RTD-activities

Pilot Plants (2) example for “Marine Biorefinery”

Production of Microalgae (Stuttgart-Fraunhofer IGB, Subitec GmbH): High value products from CO₂ for feed, food, pharmacy, cosmetics

- *Location: Stuttgart-Vaihingen*
- *Operation: 8/2007?*
- *Scale: 5000 -10000 L (400 m² area)*
- *Feedstock: polluted Water, CO₂*
- *Costs: ca. 600 t € (BioPro-High-Tech-Gründerfond)*

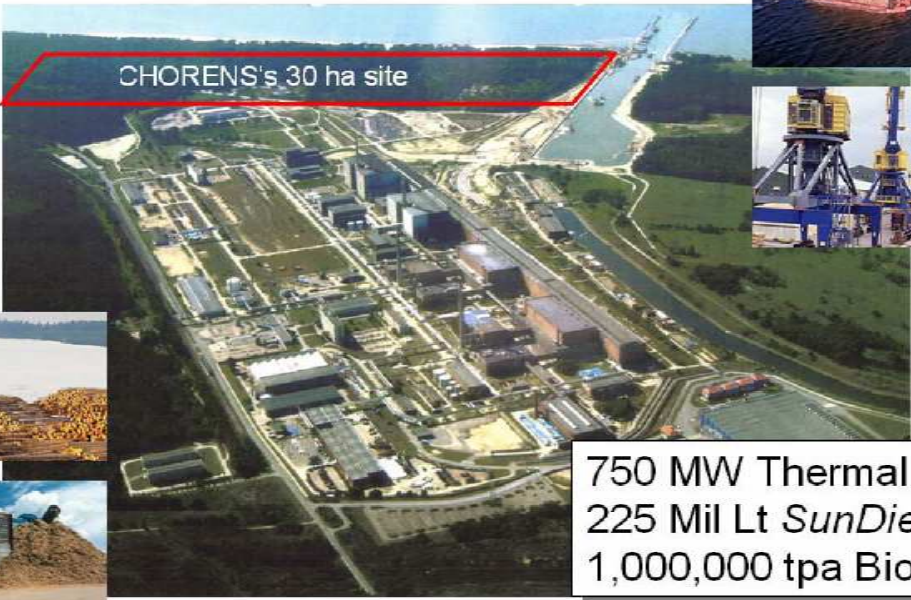
5. RTD-activities

Demonstration Plants (1)





BTL-Choren




Lubmin ~ SunDiesel® ab 2008



CHOREN'S 30 ha site



750 MW Thermal
225 Mil Lt SunDiesel
1,000,000 tpa Biomasse

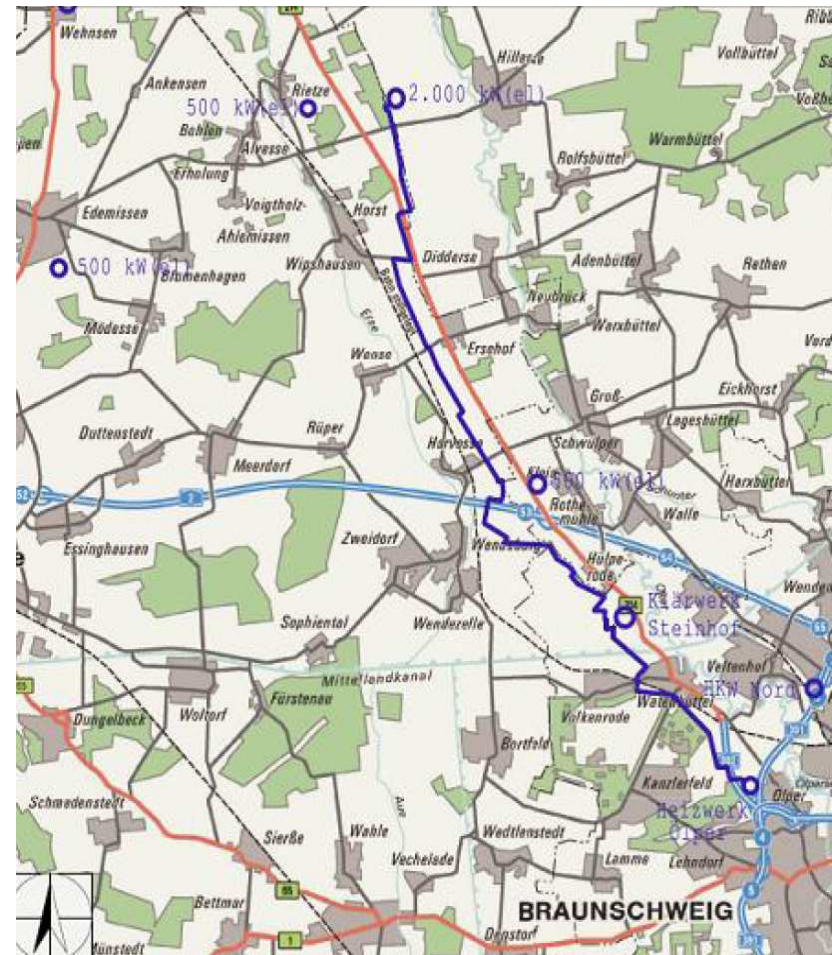


5. RTD-activities

- **Biogas plant Hillerse (near Hannover/Braunschweig)**
 - 2x 5000 m³
 - 2,5 MW_{el}
- **Powerplant BS-Ölper**
 - heat is used
- **20 km biogas pipeline**
 - Hillerse-Braunschweig/Ölper
 - optional further user (Steinhof, Ölper)
 - delivering since Sept. 2007

source: BS-Energy, Veolia 2007

Demonstration Plants (2) *Germany's first biogas-pipeline*



5. RTD-activities

Demonstration Plants (2)

Germans first biogas-pipeline

- New constructed bio-CHP in Braunschweig-Ölper
- Exemplary model for Germany
- Burning of ca. 7 Mio. m³ biogas per year (38 Mio. kWh/y)
- Heat production ca. 16 Mio kWh (1000 households)
- Power-feeding ca. 15 Mio. kWh (3800 households)
- CO₂-reduction of ca. 7,200 t by substitution of 4.2 Mio. m³/y



Quelle: BS-Energy, Veolia 2007

5. RTD-activities

Demonstration Plants (concept)

Green Biorefinery Brandenburg



- Coordination: Research Institute Biopos e.V., Teltow-Seehof, Germany (together with industrial partners)
- The Green Biorefinery Demonstration Plant in State of Brandenburg (Germany)
- produce green juice for production of high valuable proteins and fermentation juice (lactic acid fermentation).
- Press cake is used for fodder. (30 kt/a) alfalfa, wild mix gras)
- first step construction 2008

5. RTD-activities

Demonstration Plants (cooperation)

Lignocellulosic Feedstock Biorefinery



- Cooperation project Iceland-Germany, biorefinery.de GmbH, Potsdam, Germany
- LCF to Ethanol Demonstration plant is established in Iceland, Region Fludir.
- scale: 20 kt/a.

5. RTD-activities

Demonstration Plants (others)

Bioenergy-village Jühnde, biogas-production, biomass powerplant, local heat net

www.bioenergiesdorf.de

funded by BMELV-FNR and Lower Saxony and others



*Real-project: decentral energy production and local utilisation,
energy-mix (biomass, sun, wind)*

6. Major National Stakeholders I

Policy

- *Ministries (funding) BMELV, BMBF, BMU and federal states*

Industry (only selection)

- *Mineral Oil Industry (Shell, BP)*
- *Automotive Industry: VW (sunfuel, ethanol), Daimler (Synfuel), Ford (E85)*
- *Chemical Industry: Südzucker, Degussa, BASF, Henkel*
- *Plant manufacturer: Uhde, Linde, BMA a.o.*
- *Brain, Genialab, Cutec and many others: spin offs, technology transfer, innovative technologies, Enzymes, special solutions*

6. Major National Stakeholders II

Research (only selection)

- *FAL: Chemicals from sugar/starch, oil or their byproducts, biotechnology, chemical catalysis, technology transfer*
- *Fraunhofer (-IME, -ICT, -WKI): e.g. Research on monomers from renewables*
- *Leibniz-Institutes (ATB-Bornim): green biorefinery*
- *Universities (research)*
- ...

6. Major National Stakeholders III

Vision and concepts:

- *BioVision 2030 Group (Dow, FHG-ICT, biorefinery.de, biopos u.a.)*
- *Bioraffinerie-network middle-east (InnoRegio, Innovative growth center of BMBF)*
- *DECHEMA-research group „LCF-Bioraffinerie“*
- *„Osnabrücker Diskussion group“ of DBU between research and Industry*